Impact of Microphysical Consistency between Subgrid and Grid-Resolved Cloud

Parameterizations on QPF and Simulated Radar Reflectivity

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Assumed microphysical properties are usually inconsistent between the grid-resolved and subgrid cloud parameterization schemes used in operational numerical weather prediction models. This inconsistency arises because the two schemes generally apply different levels of complexity in parameterized microphysical processes due to assumed differences in spatial and temporal scales between grid-resolved and subgrid cloud parameterizations. In particular, when a double- moment formulation is used in the grid-resolved cloud parameterization scheme, and the coupling between the two schemes is achieved through only the mass-related moment, the values of the total number concentration for individual hydrometeors in the two schemes are likely to be different due to the different particle size distributions (PSDs) that are assumed in each scheme. In this presentation, it will first be shown that such an inconsistency makes it difficult to evaluate grid-resolved cloud parameterizations and interpret simulated radar reflectivity. Then, it will be shown that the inconsistency is more problematic when the double-moment formulation is used in the grid-resolved cloud parameterization scheme. It will be demonstrated that these problems can be alleviated by using the same PSDs and mass-dimension relationships in the two schemes. Moreover, it will be strongly advanced that it is physically preferable to unify microphysical assumptions between the grid-resolved and subgrid cloud parameterization schemes in weather and climate models that are run within the "grey zone" (~1 to 10 km) of horizontal resolutions in which there is significant overlap of microphysical properties between the grid-resolved and subgrid clouds.